Base Case Modeling Changes, Modifications, and Improvements

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Presented to:
Utah PM_{10} SIP Modeling Workgroup
at Salt Lake City, Utah

June 13, 2001

Prior Simulations

- Base 7 – MM5 Winds
  - Horizontal Advection is the principal loss mechanism in “problem” areas
- Base 17a - Hybrid Wind Field
  - Objective analysis of selected sites in Mix Layer
  - MM5 Winds above Mix Layer

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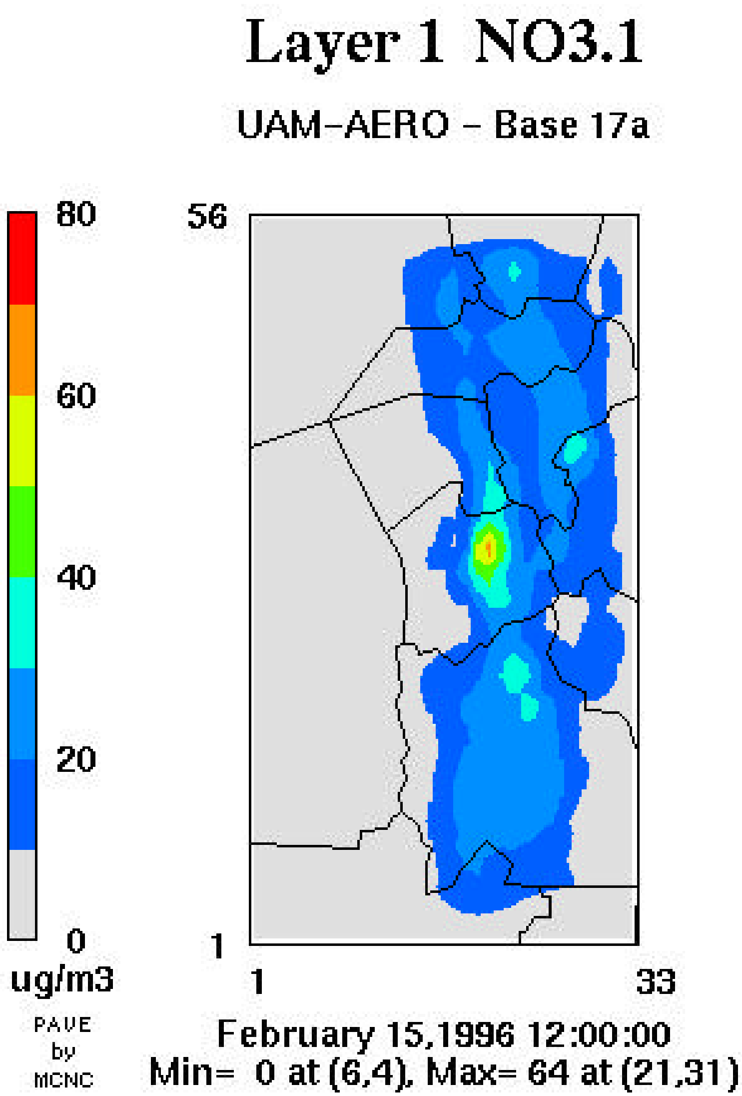
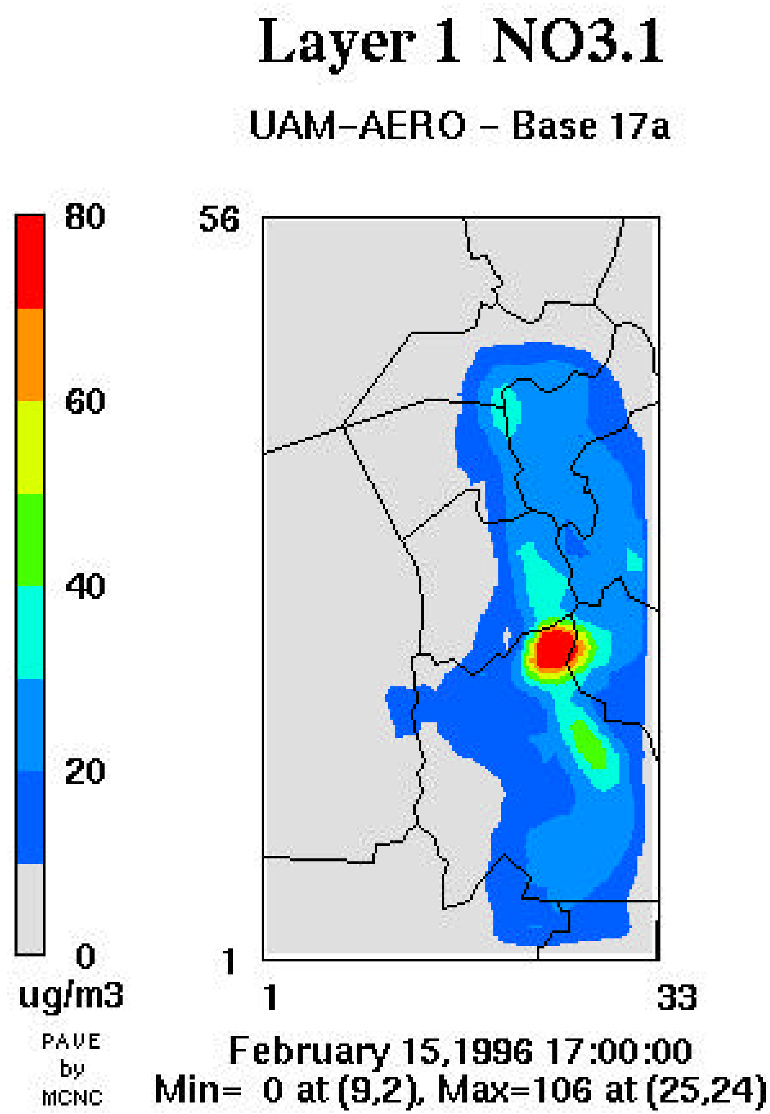
Base 17a Results





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Base 32S1

- Hybrid DWM-MM5 Winds
  - SODAR data
  - Terrain Blocking
  - Vertical Velocity Minimization at Diffusion Break
- ABLM Mixing Model for Diffusion Break
- Meteorological Variables Re-Mapped Vertically
- UAM-AERO Modifications
  - Neutral Stability at Night in Urban Areas
  - SO_2 -> H_2SO_4 rates modified in Empirical Fog Model

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General Results

- Peak Concentrations Mostly Contained in the Salt Lake Valley
- Predicted Peaks Still Remain to the South and East of Observed
- Some Diffusion of PM Mass into the Wasatch Front
- Higher Diffusion Break Height at Night in Urban Areas Resulting in Lower Nighttime PM10

Model Performance Evaluation

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Approach

- Performance Criteria for UAM-AERO
  - Use in an Absolute Attainment Demonstration
  - Use in a Relative Attainment Demonstration
- Statistics – Speciated Particulate Matter
  - Normalized Mean Bias
  - Normalized Mean Error
  - Peak Prediction Accuracy
- Graphical Analysis
- Sensitivity Tests
- Data Type and Quantity
- Common Sense

Definitions

- Normalized Mean Bias
- Normalized Mean Error
- Peak Prediction Accuracy

Criteria for Absolute Attainment Demonstration

- Normalized Mean Bias: +/- 15%
- Normalized Mean Error: 35%
- Unpaired Peak Prediction Accuracy: 20%
- Graphical: Modeled and observed species for the episode chemically, spatially, and temporally consistent.
- Sensitivity: Responses for important secondary species consistent with understanding of the processes leading to their formation.
- Data: Type and quantity sufficient to perform statistical and graphical tests for all species indicated.

Criteria for Relative Attainment Demonstration

- Normalized Mean Bias: +/- 50%
- Normalized Mean Error: 50%
- Mass and Chemical Components
- Somewhat Arbitrary

Base 32S1 Normalized Mean Bias (%)

Date	Area	PM10	OTR	NO3	SO4	NH4	OC	EC	CL	NA
Feb 14	SLC	-35	-25	-47	-65	-46	-47	+22	-71	-55
	UC	-17	-14	-18	-71	-7	-43	+19	+30	+166
	ALL	-17	-13	-24	-70	-18	-33	+17	-5	+84
Feb 15	SLC	-40	-24	-47	-55	-46	-42	+54	-62	-30
	UC	-33								
	ALL	-23	+55	-44	-54	-41	-19	+16	+30	+9

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Base 32S1 Normalized Mean Error (%)

Date	Area	PM10	OTR	NO3	SO4	NH4	OC	EC	CL	NA
Feb 14	SLC	35	25	47	65	46	47	22	71	55
	UC	37	56	18	71	11	43	35	74	187
	ALL	29	39	24	70	20	38	26	67	128
Feb 15	SLC	40	24	47	55	46	42	67	62	31
	UC	33								
	ALL	28	76	44	54	41	38	47	127	37

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Other Evaluations

- Time Series
- Spatial Plots
- Animations
- Scatter Plots
- Speciation

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Hourly Time Series

Relative Reduction Factors

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Relative Reduction Factors

- Absolute Reduction Factors
- What is a Relative Reductions Factor?
- When Should They be Used?

Rationale

- Acknowledges Uncertainty in Predictions
- Anchors Model Estimates to Observations
- Retains Elements Predictive Chemistry and Physics unlike Speciated Rollback or Chemical Mass Balance

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Calculation

- Base Case Concentration (C_b)
- Control Scenario Concentration (C_c)
  - Future Year with Growth and Controls Already "on the books"
  - Future Year Control Scenarios
- Relative Reduction Factor (RRF)

$$RRF = C_c / C_b$$

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Application

- Site Specific Design Values
- Component Specific Design Values
- Calculate Site Specific RRFs
- Apply RRFs to Component Specific Design Values, Site-by-Site
- Compare to Standard

Example 1 of 3

- Design Value
  - 160 ug/m^3 PM10
  - 40 ug/m^3 NO3
  - 40 ug/m^3 OC
  - 80 ug/m^3 OTR
- Base Case
  - 120 ug/m^3 PM10
  - 30 ug/m^3 NO3
  - 20 ug/m^3 OC
  - 70 ug/m^3 OTR

Example

- Control
  - 105 ug/m^3 PM10
  - 15 ug/m^3 NO3
  - 15 ug/m^3 OC
  - 75 ug/m^3 OTR
- Calculate RRFs by Component
  - $RRF_{NO3} = 15/30 = 0.50$
  - $RRF_{OC} = 15/20 = 0.75$
  - $RRF_{OTR} = 75/70 = 1.07$

Example 3 of 3

- Apply to Design Value

  NO3: 0.50 * 40 = 20

  OC: 0.75 * 40 = 30

  OTR: 1.07 * 80 = 86

  SUM: 20 + 30 +86 = 136

- Compare to Standard

  $136 \leq 155$

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